

JAXA PMM Program Status

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Japanese PMM Science Team

* The current Japanese PMM Science Team started in Apr. 2019 for three-year period.

* 33 proposals for the EO-RA-2 (JFY2019-2021)

- ✓ This RA includes almost all Earth Observation (EO) missions in JAXA.

- ✓ Recently, two late proposals were accepted.

* 25 with research cost proposals

* 8 no cost transfer proposals including 6 from abroad

* Research Category

- ✓ Algorithm development: 9

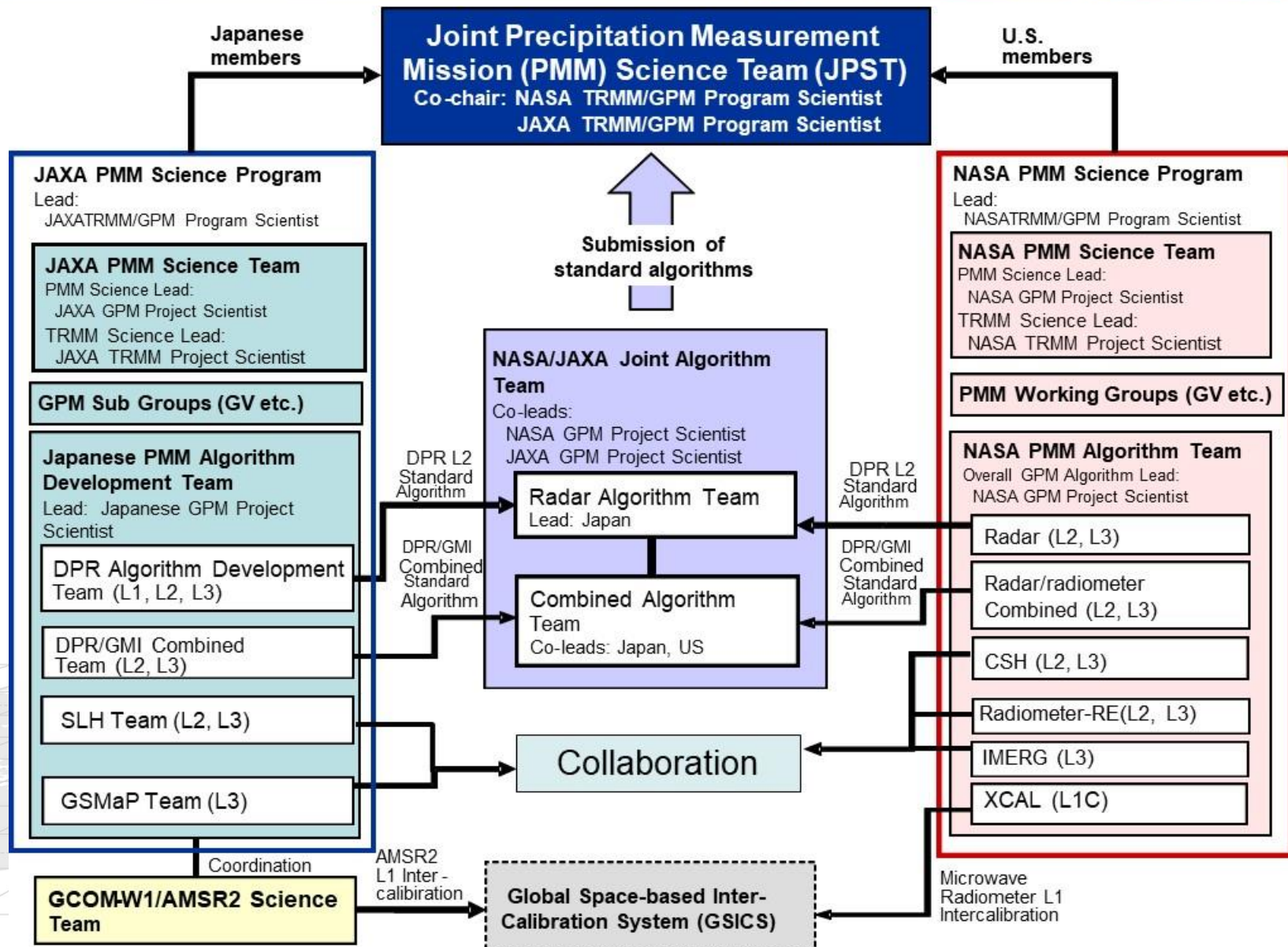
- ✓ Validation: 13

- ✓ Application research: 11

Japan and U.S. PMM Science Framework



-- two joint algorithm development teams --



DPR Sensor Status

- * DPR anomaly events that occurred between April and May 2020 are summarized below.
 - * 22 April 2020
 - * 2 May 2020
 - * 20 May 2020
- * JAXA judged these occurred due to transient events such as **single event upset (SEU)**, which caused some temporal problems of a memory in the DPR instruments.
- * Since 20 May 2020, there have been **no similar events**. JAXA continues to monitor the DPR status.

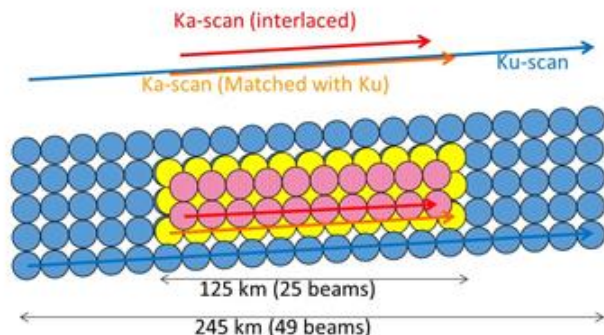
All data collection is now nominal and instruments are in good condition.



KaPR's scan pattern change (May 2018)

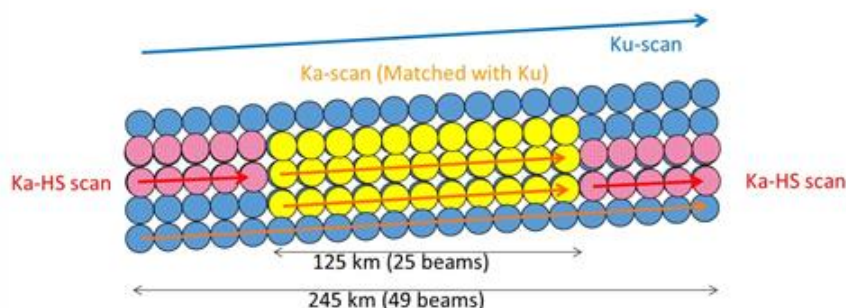
Before 21 May 2018

- Ku footprint (245 km swath with 49 beams)
- Ka footprint (125 km swath, matched with Ku, 250 m range res.)
- Ka footprint (Interlaced, 500 m range res., high sensitivity)



After 21 May 2018

- Ku footprint (245 km swath with 49 beams)
- Ka footprint (matched with Ku in inner swath, 250 m range res., low sensitivity)
- Ka HS footprint (matched with Ku in outer swath, 500 m range res., high sensitivity)



* The KaPR's scan pattern has been changed in May 2018.

* JAXA and NASA have started to **release the DPR-L2/L3 V06X** in June 2020.

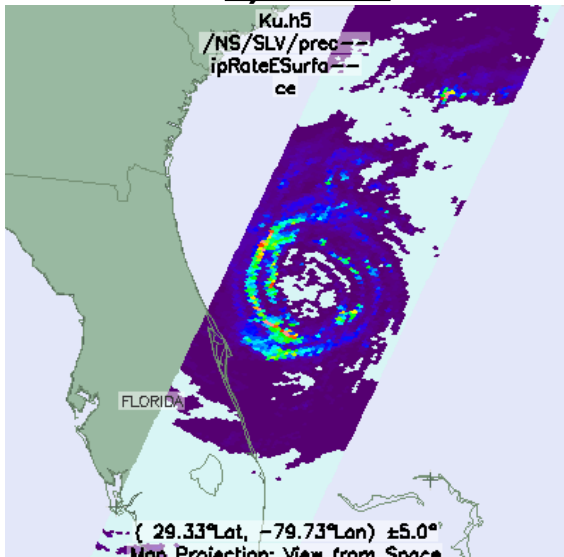
* V06X data products are available from May 21, 2018 orbit: 024021 and forward.

* V06X products are generated in parallel with the standard V06 products (V06A) which remain unchanged.

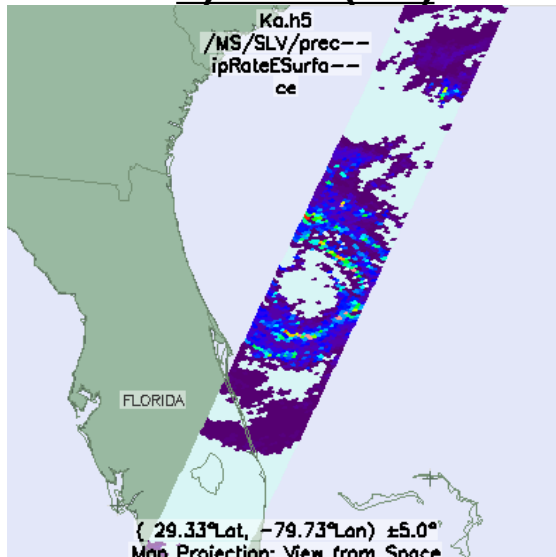
Hurricane Dorian case in DPR V06X

Color in Figures: DPR L2 surface precipitation rate

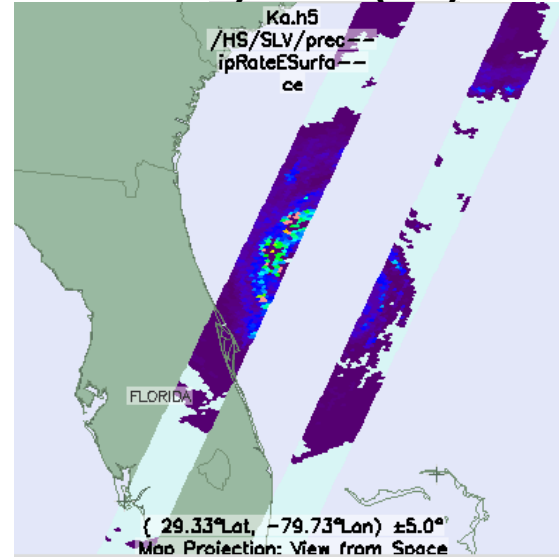
a) KuPR



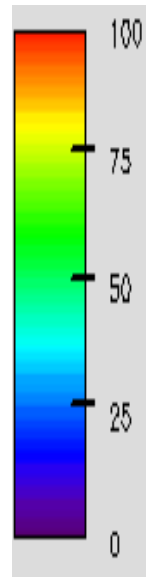
b) KaPR(MS)



c) KaPR(HS)



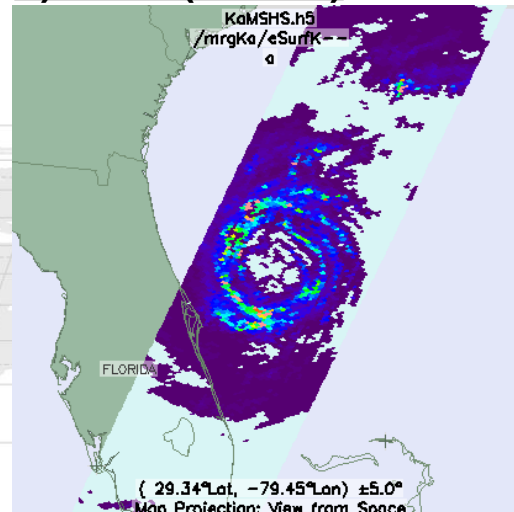
[mm/h]



Hurricane Dorian
2019/09/04 10:35(UTC)

Dual-frequency technique can be applied in a full swath, which can enable us more accurate estimates in the full swath.

d) KaPR(MS/HS)

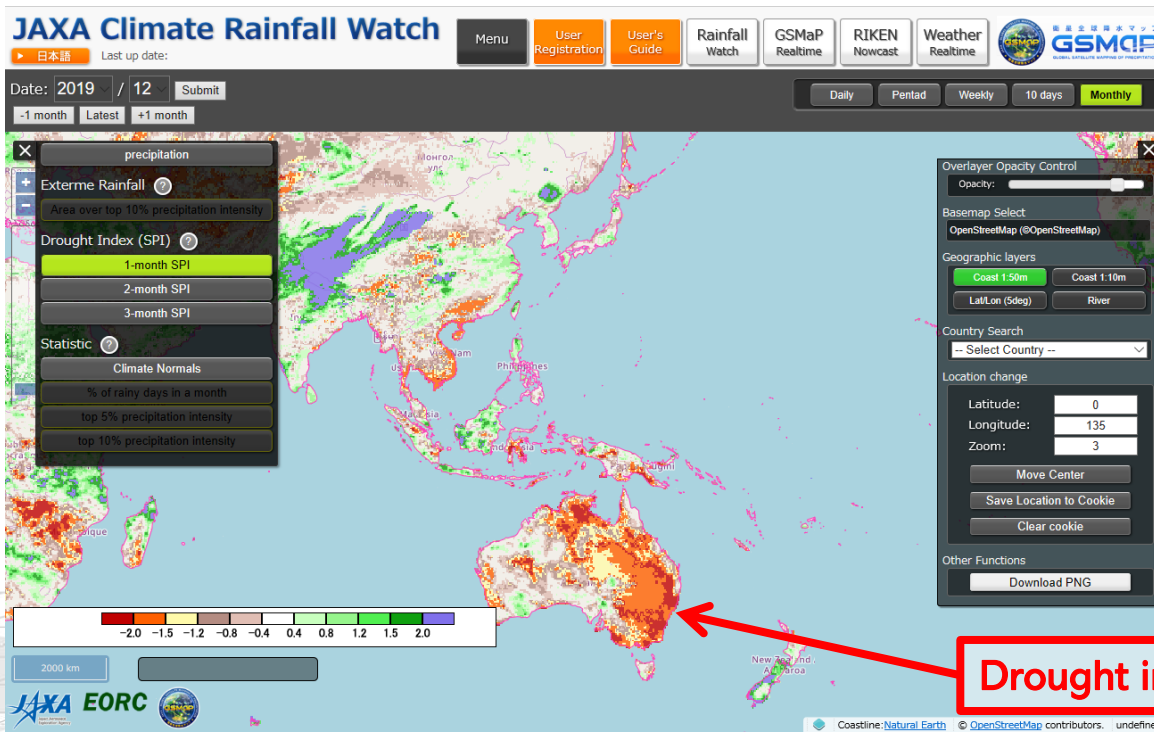


GPM Algorithm Development Status (Summary)

- * GPM/DPR Level 1 algorithm (JAXA)
 - * V05 product was released in May 2017.
 - * [See later Prof. Takahashi's presentation for the V07 plan.](#)
- * DPR Level 2 and 3 algorithm (Joint Japan-U.S.)
 - * V06A product was released in Oct. 2018.
 - * V06X product was released in Jun. 2020.
 - * [See later Prof. Takahashi's presentation for the V07 plan.](#)
- * DPR Latent heating algorithm (Japan-U.S.)
 - * DPR Spectral Latent Heating (SLH) V06A product was released in Oct. 2018 and V06B product was released in Jul. 2020.
 - * [See later Prof. Takayabu's presentation for the SLH status.](#)
- * Global Rainfall Map algorithm [GSMaP] (Japan)
 - * V04 Product was released in January 2017.
 - * V05 Product is scheduled to be released in January 2020.
 - * [See later Dr. Kubota's presentation for the V05 plan.](#)

JAXA Climate Rainfall Watch

- We started to operate a homepage “JAXA Climate Rainfall Watch”, which provides information about extreme heavy rainfall and drought over the world using the GSMaP.



Displaying accumulated rainfall in some temporal scale (**daily, pentad, weekly, 10-days and monthly**), indices related to extreme heavy rainfall and drought.

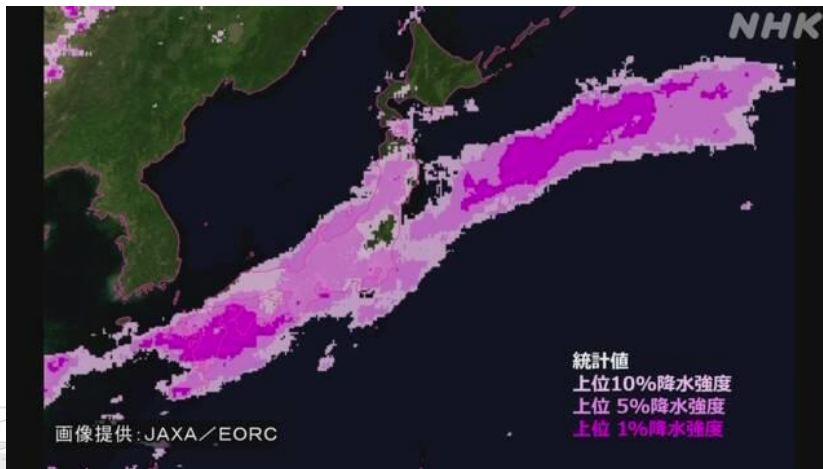
Detection of heavy rainfall and drought is based upon Tashima et al. (2020, *JSTARS*).
<https://doi.org/10.1109/JSTAR.S.2020.3014881>

Drought in Australia (December 2019)

Graphical User Interface of the "JAXA Climate Rainfall Watch" website
(https://sharaku.eorc.jaxa.jp/GSMaP_CLM/)

Utilization in Japanese TV News

- * Japan experienced heavy rainfall in July 2020, causing serious damages.
- * Our GSMaP result to detect heavy rainfall in July 2020 was **reported in Japanese TV (NHK) News.**
 - * NHK (Japan Broadcasting Corporation) is Japan's only public broadcaster.



Extreme heavy rainfall area above 90th percentile for weekly precipitation (July 1-7, 2020), used in the NHK TV News



Moeka Yamaji (JAXA/EORC) remotely explained this in the NHK TV News.

Awards to Japanese PMM researchers

- ✧ Recently, the Meteorological Society of Japan (MSJ) awarded **Prof. T. Ushio (Osaka Univ.)**.



- ✧ Horiuchi Award in 2020

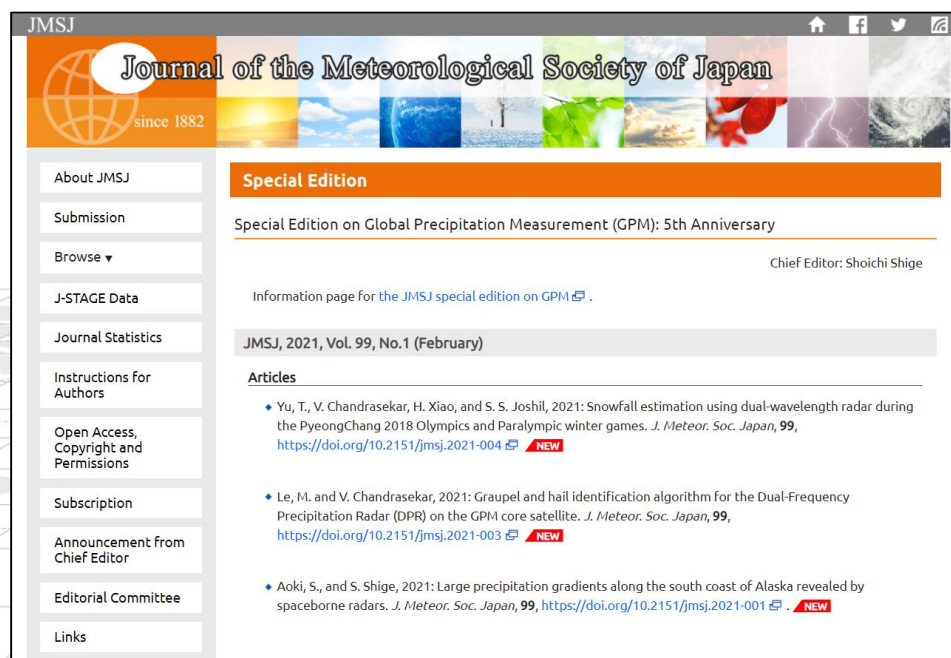
- ✧ Prof. Tomoo Ushio for his achievements of **GSMaP** and Phased Array Weather Radar

- ✓ (For your information: Dr. Toshio Iguchi received Horiuchi Award in 2015, and Dr. Ken'ichi Okamoto received it in 1993.)

- ✧ In 2021 Awards and Honors Recipients, American Meteorological Society (AMS) announced **Prof. Y. N. Takayabu (Univ. Tokyo)** as Fellows.

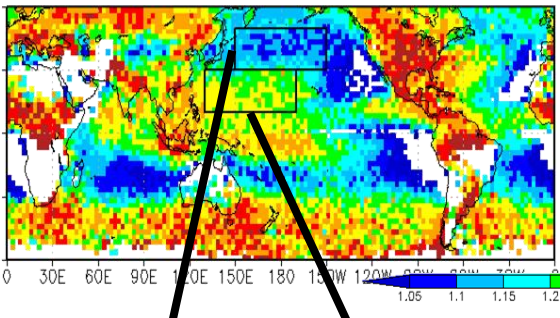
- ✧ <https://www.ametsoc.org/index.cfm/ams/about-ams/ams-awards-honors/2021-awards-and-honors-recipients/>

- * 33 papers were submitted to the GPM Special Edition in Journal of the Meteorological Society of Japan (JMSJ).
 - * The submission was closed at the end of Sep. 2020.
- * You can see the papers from the following URL.
 - * http://jmsj.metsoc.jp/special_issues_editions/GPM.html
 - * 11 papers were already accepted.

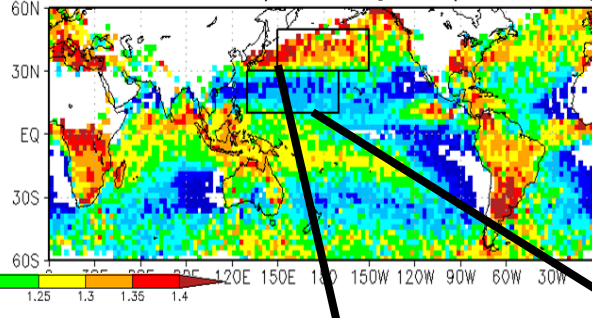


Global Drop Size Distribution and its seasonal variations derived by DPR (Yamaji et al. 2020, *JMSJ*)

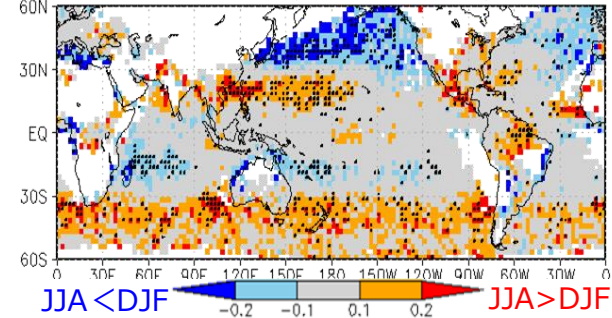
Diameter in **JJA** (2014-2018)



Diameter in **DJF** (2014-2018)

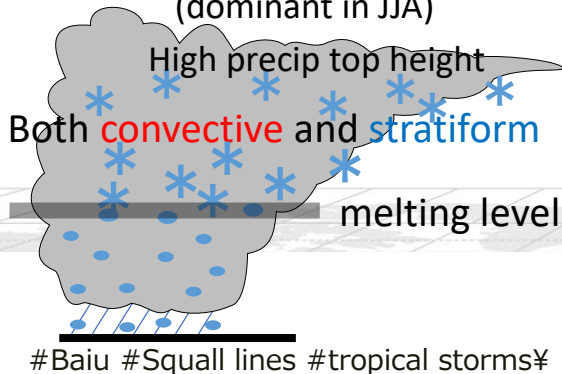


Diff. of Diameter in **JJA - DJF**

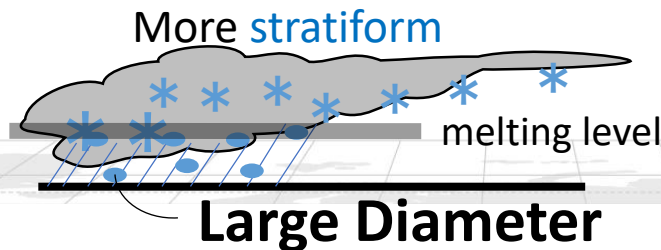


Diameter data in DPR-L2 product show statistically significant seasonal variations, which can be related to the changes in dominant precipitation systems.

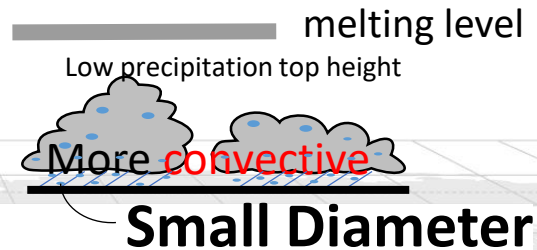
↓ Different Types of
Organized Precipitation System
(dominant in JJA)



↓ **Extratropical Frontal System**
(dominant over mid-latitudes in DJF)



↓ **Shallow Convective System**
(dominant over subtropics in DJF)



M. Yamaji, H. G. Takahashi, T. Kubota, R. Oki, A. Hamada, and Y. N. Takayabu, 2020: 4-year Climatology of Global Drop Size Distribution and its Seasonal Variability Observed by Spaceborne Dual-frequency Precipitation Radar, *J. Meteor. Soc. Japan*, Vol. 98, Issue 4, Pages 755-773. <https://doi.org/10.2151/jmsj.2020-038>

Springer book

“Satellite Precipitation Measurement”

- ❄ 12 papers related to Japanese PMM researchers were published in Springer book “Satellite Precipitation Measurement”.

Volume 1

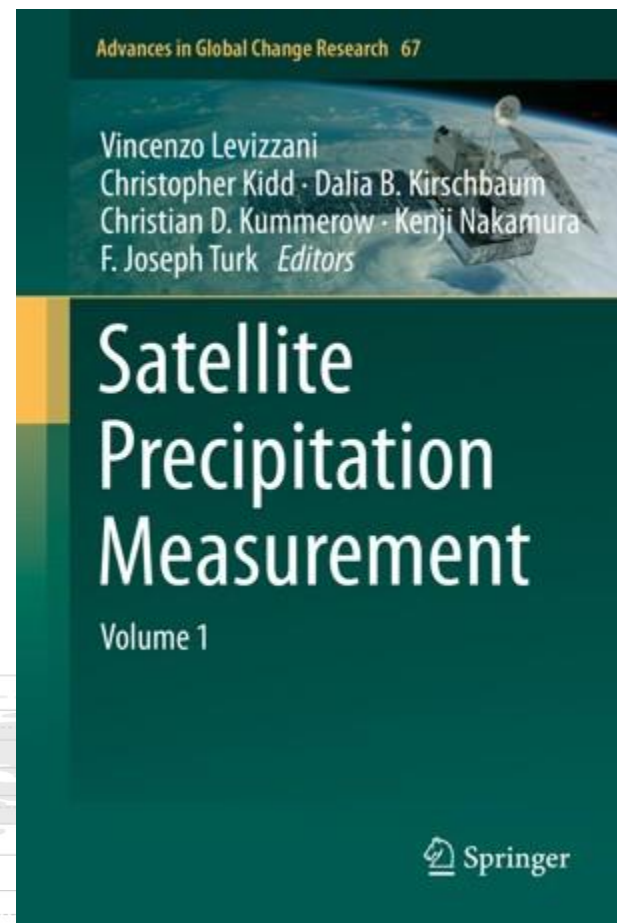
<https://link.springer.com/book/10.1007%2F978-3-030-24568-9>

Volume 2

<https://link.springer.com/book/10.1007%2F978-3-030-35798-6>

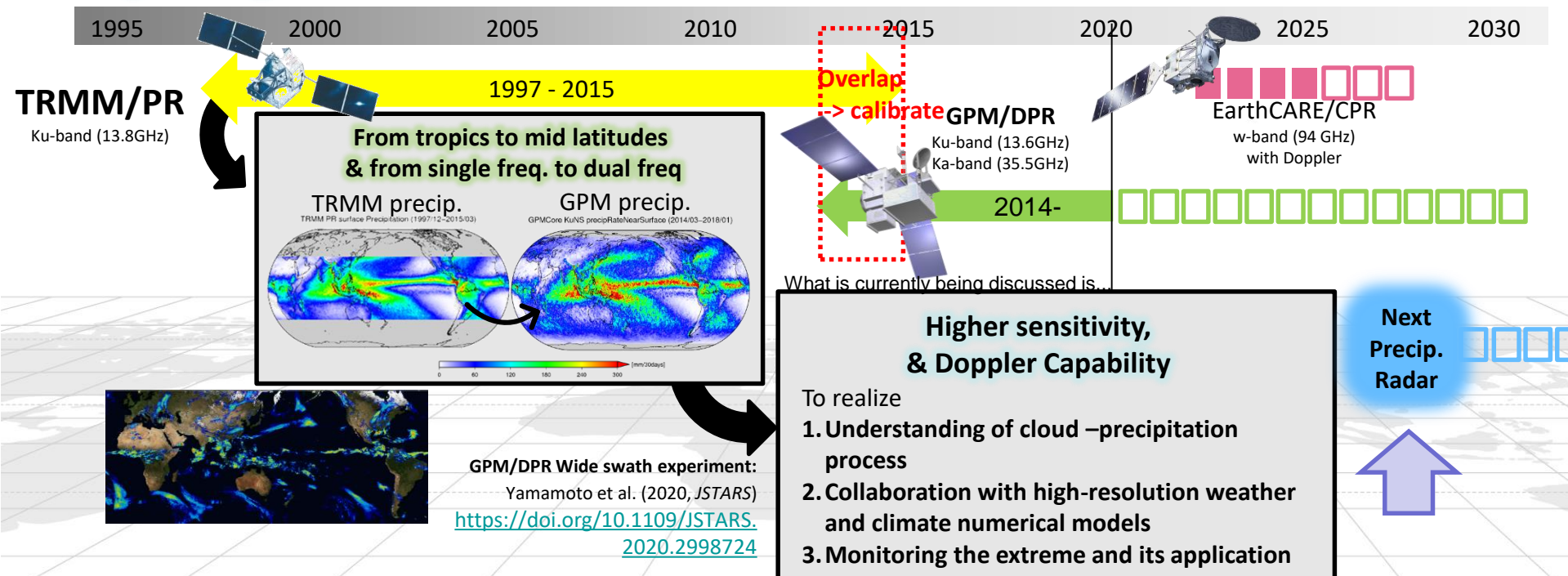
Books include;

- Aonashi and Ferraro (2020) Microwave Sensors, Imagers and Sounders.
- Iguchi and Haddad (2020) Introduction to Radar Rain Retrieval Methods.
- Iguchi (2020) Dual-Frequency Precipitation Radar (DPR) on the Global Precipitation Measurement (GPM) Mission's Core Observatory.
- Kubota et al. (2020) Global Satellite Mapping of Precipitation (GSMaP) Products in the GPM Era.
- Oki, Iguchi, and Nakamura (2020) The GPM DPR Validation Program.
- Hamada, Iguchi, and Takayabu (2020) Snowfall Detection by Spaceborne Radars.
- Takayabu and Tao (2020) Latent Heating Retrievals from Satellite Observations.
- Miyoshi et al. (2020) Precipitation Ensemble Data Assimilation in NWP Models.



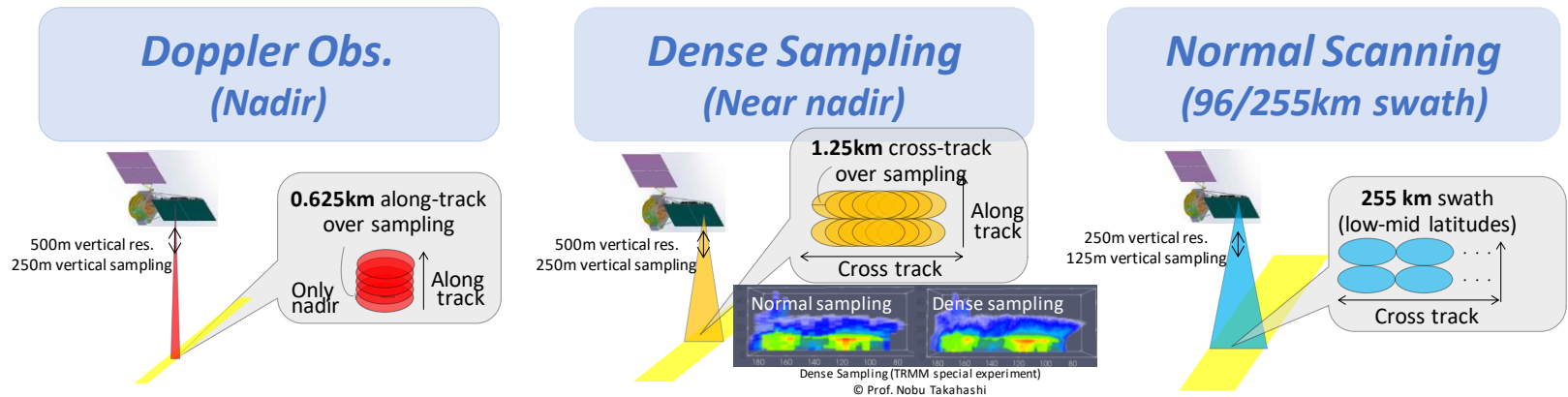
Next Generation Precipitation Radar discussed in JAXA (1)

- The JAXA has studied a feasibility of a next generation precipitation radar with Japanese science team and user community.
 - ✓ The JAXA has discussed with NASA in the Aerosol and Cloud, Convection and Precipitation (ACCP) study.
- Our targets for the next generation precipitation radar will be **Doppler Observations, Higher sensitivity measurements with scanning capability.**

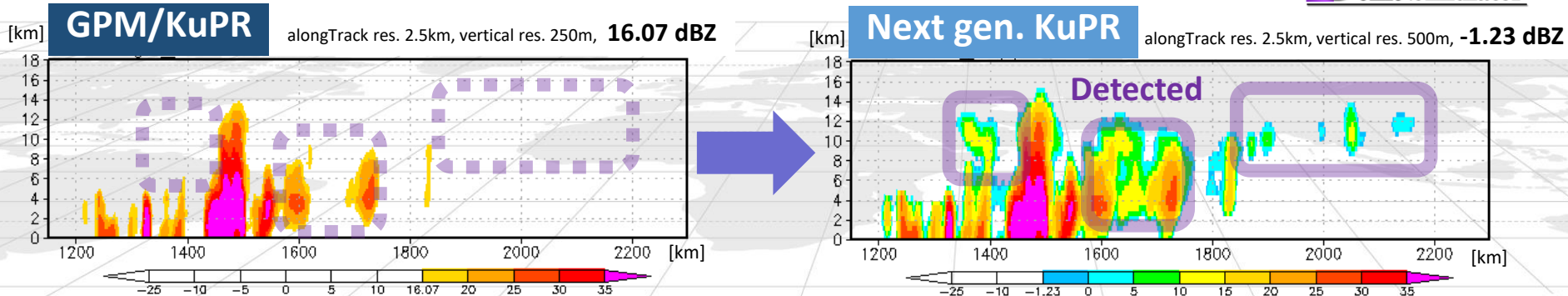


Next Generation Precipitation Radar discussed in JAXA (2)

- The next generation KuPR (KuPR-2) is now designed as a precipitation radar capable of **Doppler Observations**, with **Higher sensitivity measurements** than the current GPM/KuPR.



Simulation results Joint-simulator and NICAM data
jointly working with Prof. M. Satoh and Dr. Woosub Roh (Univ. Tokyo)



PMM-related JAXA updates:

Current status of AMSR3

* GOSAT-GW(Global Observation SATellite for Greenhouse gases and Water cycle) will carry two instruments, **AMSR3** and TANSO-3.

* **AMSR3**, led by JAXA, will succeed AMSR series observations adding **new high-frequency channels** for solid precipitation retrievals and water vapor analysis in NWP.

* Target launch is **JFY2023** (Apr. 2023 - Mar. 2024)

* AMSR3 status

* Impacts of new high-frequency channels were carefully evaluated and the final decision was to add **166V, 183+-3V and 183+-7V** channels to AMSR3 for snowfall retrieval and water vapor analysis in NWP

GOSAT-GW Satellite Specifications

Orbit	Type	Sun-synchronous, Sub-recurrent orbit
	Altitude	666km, recurrent cycle 3days (same as GOSAT)
	MLTAN	13:30±15min (same as GCOM-W)
Mass		2.6 ton (Including propellant)
Power		> 5.3 kW
Design life		7 years
Launch vehicle		H-IIA rocket
Mission data downlink rate		Direct transmission with X-band: 400 Mbps Direct transmission with S-band: 1 Mbps (Only for AMSR3)
Instrument		TANSO-3 (for GHG) AMSR3 (for Water Cycle)

AMSR3 Channel Sets

Center frequency [GHz]	Polarization	Band width [MHz]	NEDT (1σ)	Beam width (spatial resolution)
6.925 7.3	H/V	350	< 0.34 K	1.8° (34km x 58km)
10.25	H/V	500	< 0.34 K	1.2° (22km x 39km)
10.65	H/V	100	< 0.70 K	1.2° (22km x 39km)
18.7	H/V	200	< 0.70 K	0.65° (12km x 21km)
23.8	H/V	400	< 0.60 K	0.75° (14km x 24km)
36.5	H/V	1000	< 0.70 K	0.35° (7km x 11km)
89.0 A/B	H/V	3000	< 1.20 K	0.15° (3km x 5km)
165.5	V	4000	< 1.50 K	0.3° (TBD) (6km x 10km)
183.31±7	V	2000 × 2	< 1.50 K	0.28° (TBD) (5km x 9km)
183.31±3	V	2000 × 2	< 1.50 K	0.28° (TBD) (5km x 9km)

Summary

- * The Japanese PMM Science Team started in Apr. 2019 for three-year period.
 - * 33 proposals for the EO-RA-2 (JFY2019-2021)
- * GPM/DPR instrument is now working well, although it experiences anomalies in April-May 2020.
- * DPR products V06X were released in June 2020.
- * PMM-related news
 - * Awards by the Meteorological Society of Japan (MSJ) and American Meteorological Society (AMS)
 - * GPM 5th Anniversary special edition in JMSJ
 - * Springer book “Satellite Precipitation Measurement”
- * AMSR-3 status
- * Next Generation Precipitation Radar discussed in JAXA